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The proportional values of α , β , γ in (5) and (6) are given by

$$\frac{\alpha'}{m_1 n_2 - m_2 n_1} = \frac{\beta'}{n_1 l_2 - n_2 l_1} = \frac{\gamma'}{l_1 m_2 - l_2 m_1} \quad (9)$$

and those in (2) and (3) by

$$\frac{\alpha'}{b^3 c^3} = \frac{\beta'}{a^3 c^3} = \frac{\gamma'}{a^3 b^3} \quad (10), \quad \text{or} \quad \alpha' / \frac{1}{a^3} = \beta' / \frac{1}{b^3} = \gamma' / \frac{1}{c^3} \quad (11),$$

satisfying (4) and proving the theorem.

The fundamental triangle is in perspective with two other Brocard triangles, the centers of perspective being $1/b^2$, $1/c^2$, $1/a^2$; $1/c^2$, $1/a^2$, $1/b^2$.

Also solved by J. W. CLAWSON, C. P. SOUSLEY, and S. W. REAVES.

509. Proposed by NORMAN ANNING, Chilliwack, B. C.

A picture whose coördinates are $(0, 0)$, $(50, 0)$, $(50, 50)$, and $(0, 50)$ is repeated on a smaller scale as part of itself with the coördinates $(7, 0)$, $(31, 7)$, $(24, 31)$, $(0, 24)$. Locate the vanishing point.

SOLUTION BY S. W. REAVES, University of Oklahoma.

Let P, P_1, P_2, \dots denote the picture and its successive images, and let O_1, O_2, O_3, \dots be the successive images of the first vertex. We shall find the vanishing point by determining the limiting position of O_n as n increases indefinitely.

It readily follows from the data of the problem that the side of P_1 is one half that of P and makes with it an angle $\theta = \tan^{-1} 7/24$. It is clear that the side of P_n bears the same relations to the side of P_{n-1} for all values of n .

By projecting the successive segments $OO_1, O_1O_2, O_2O_3, \dots$ on the coördinate axes, it readily follows that the coördinates of the limiting position of O_n are given by the following infinite series:

$$x = 7 + \frac{7}{2} \cos \theta + \frac{7}{2^2} \cos 2\theta + \dots + \frac{7}{2^n} \cos n\theta + \dots,$$

$$y = \frac{7}{2} \sin \theta + \frac{7}{2^2} \sin 2\theta + \dots + \frac{7}{2^n} \sin n\theta + \dots$$

Multiplying the second equation through by $i = \sqrt{-1}$, adding the result to the first equation, denoting $\cos \theta + i \sin \theta$ by v , and remembering that $\cos n\theta + i \sin n\theta$ is by De Moivre's formula equal to v^n , we have

$$x + iy = 7 \left[1 + \frac{v}{2} + \left(\frac{v}{2}\right)^2 + \dots + \left(\frac{v}{2}\right)^n + \dots \right].$$

Using the formula for the sum of a geometric progression and then replacing v by its value

$$\frac{24}{25} + i \frac{7}{25},$$

we have

$$x + iy = \frac{364}{29} + i \frac{98}{29}.$$

Hence, the coördinates of the required vanishing point are $(364/29, 98/29)$.

Also solved by J. B. REYNOLDS and W. R. RANSOM.

CALCULUS.

424. Proposed by OSCAR S. ADAMS, Washington, D. C.

What is the value of

$$\frac{\Gamma'(1)}{\Gamma(1)} - \frac{\Gamma'(\frac{1}{2})}{\Gamma(\frac{1}{2})}.$$